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Who will use the data?

The data collected under this QAPP addendum will be used by CPG and Region 2 USEPA for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)-related decisions, specifically for refining bioaccumulation model to characterize future risk, for the evaluation of remedial alternatives and to support remedial decision-making in the 17-mile LPRSA.

What will the data be used for?

The data collected from this sampling event will be used to verify and refine the trophic transfer CSM and to refine the bioaccumulation model.

Sediment Profile Imagery

- Refresh SPI database (current as of 2005).
- Provide profile images and relevant data for 78 by depth horizon locations and refine benthic exposure zone defined by the abundance data in the CSM.

Abundance and biomass by depth horizon

- Document the abundance and biomass of benthic invertebrates within defined sediment depth horizons.
- Determine the proportion of abundance and biomass among several depth horizons.
- Establish the depth horizon within which the majority of exposure can be expected based on abundance proportions to define the benthic exposure zone.
- Provide evidence to support the trophic transfer CSM and refine the bioaccumulation model.

Benthic invertebrate tissue chemistry

- Document tissue concentrations in benthic invertebrates within the benthic exposure zone.
- Determine site-specific and sampling location-specific bioaccumulation in benthic invertebrates residing in the benthic exposure zone.
- Refine the bioaccumulation model.

Taxonomy

- Identify the species residing in the benthic exposure zone within the LPRSA.
- Evaluate (using literature) the feeding strategies of benthic invertebrates found in the benthic exposure zone.

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Verify and refine the trophic transfer CSM and refine the bioaccumulation model.

What types of data are needed?

Sediment Profile Imaging

SPI data will be collected to provide an indication of the change in benthic communities and sediment conditions since the 2005 survey by Germano & Associates (2005).

Abundance and biomass by depth horizon

Sediment will be collected at 78 locations for analysis of abundance by depth horizon. The number of benthic community abundance samples will be evenly split among the three salinity zones and across the grain size strata. Abundance of benthic invertebrates will be based on a numerical count of benthic organisms collected in each benthic depth horizon. Benthic depth horizon will be categorized as one of the following sampling horizons: 0–2, 2–4, 4–10, or 10–15 cm. The relative abundance will then be calculated for each benthic depth horizon and compared to conclusions presented in the trophic transfer CSM. These depth horizons are based on the following rationale:

- CPG's current CSM uses a benthic exposure zone of 0–2 cm, which is based on the mean/median aRPD layer depth reported by Germano & Associates (2005).
- A depth of 2–4 cm incorporates uncertainty and variability around the mean/median aRPD layer depth.
- The remaining 4–15 cm were split at 10 cm to provide additional information about burrowing depths.

Biomass measurements will also be made on a subset (24) of the 78 abundance samples at the same benthic depth horizons. The number of benthic biomass samples will be evenly split between the three salinity zones and across the grain size strata. Biomass measurements will be based on the mass of invertebrate tissue, with three measurements taken: wet weight following removal of extraneous water, dry weight following drying to a constant weight in a drying oven, and ash-free dry weight (AFDW) following placement in a muffle furnace using standard methods (SMs) (Attachment BB).

Benthic invertebrate tissue chemistry

Benthic invertebrate tissues will be chemically analyzed for PCB congeners and PCDD/PCDF concentrations. Tissue lipids will also be analyzed to allow for the normalization of organic chemical concentrations. Percent moisture will also be analyzed.

Taxonomy

Benthic invertebrate community samples will be collected and sieved through a 0.5-mm sieve before being sent to a taxonomy laboratory. Following standard practice, up to 300 invertebrates will be identified (Barbour et al. 1999). As stated in the *Rapid Bioassessment Protocols for Use in Streams in Wadeable Rivers* (Barbour et al. 1999), subsampling reduces the effort required for the sorting and identification aspects of marcroinvertebrate surveys, and provides a more accurate estimate of time expenditure. The

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protocol is based on a 200-organism subsample, but it could be used for a subsample of any size (e.g., 100, 300, 500). A subsample of 300 invertebrates was chosen for this program to be consistent with the methods used for freshwater community samples collected in the LPRSA (Windward 2014a, b). The invertebrates will be identified to the lowest practical taxonomic level: generally genus or species level, unless the organisms are damaged, incomplete, or juveniles, which may preclude identification to this level.

Matrix

Abundance and biomass measurements will be conducted using benthic invertebrates sieved and sorted from surface sediment samples and split into multiple depth horizons. Chemical analysis will be conducted on unpreserved composite benthic invertebrate tissue samples. Benthic invertebrate tissue for chemical analysis will be sieved and sorted prior to analysis. Taxonomic analysis will be conducted on a subset of sampling locations.

How "good" do the data need to be in order to support the environmental decision?

The data usability memorandum (Windward and AECOM [in prep]) describes the data acceptability requirements for use in the BERA and are appropriate for this survey.

How many data are needed?

Table 1 in Worksheet 10 provides the sample sizes of locations associated with the current sampling effort.

Where, when, and how should the data be collected/generated?

The following data quality objectives (DQOs) will be achieved through sampling and analysis:

1. Update the current SPI database to provide a better understanding of current invertebrate-sediment interactions and sediment characteristics and conditions (e.g., grain size,. aRPD layer depth, and the presence of active burrows, methane, or debris).
2. Determine the vertical extent of benthic invertebrates from select depth intervals within the upper 15 cm of sediment in the LPRSA, and calculate the abundance and biomass of infaunal invertebrates within the selected sediment horizons. The resulting relative abundance will be used to define the benthic exposure zone and help verify the trophic transfer CSM. Biomass data will be used to refine the benthic exposure zone defined by the abundance data in the CSM.
3. Determine tissue chemistry concentrations in field-collected benthic invertebrate tissues from the benthic exposure zone and whether these concentrations align with those expected based on bioaccumulation modeling and on estimates of future conditions.

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Determine what benthic invertebrate taxonomic groups are present in the benthic exposure zone and whether the benthic community structure and feeding strategies[1] within this sediment depth support the trophic transfer CSM.

DQO No. 1 will be addressed by a SPI survey. This will be conducted prior to or concurrently with sampling for abundance and biomass by depth horizon. SPI data will be collected from stations previously occupied (Germano & Associates 2005), as well as the 78 abundance by depth horizon locations. The SPI survey will be conducted according to the standard approach developed by Joseph Germano and others (Germano & Associates 2005).

Because the majority of the abundance and biomass is expected to be within a small interval of the surface of the sediment (e.g., 0–2 or 0–4 cm), DQO No. 2 must be addressed first in order to best address DQO Nos. 3 and 4. The depth of this surface sediment interval (i.e., the benthic exposure zone) is currently unknown, but after the analysis of abundance and biomass relative to vertical burrowing depths, it will be possible to estimate the depth within which the majority of benthic abundance and biomass can be consistently encountered during sediment collection. Sediment sampling for tissue chemistry and taxonomy will include the interval that encapsulates that majority-abundance.[2]

For the purpose of evaluating the vertical extent of benthic burrowing in the upper 15 cm of sediment, abundance and biomass samples will be collected from locations throughout the LPRSA (i.e., from the mouth of the river at Newark Bay [RM 0] to RM 16).[3] Sediment sampling will follow a stratified random pattern, with sampling locations stratified by salinity and sediment grain size.

Salinity zones provided in the BERA for benthic invertebrates (Windward [in prep]) will be used to stratify sampling. These zones include the following:

- Upper estuary zone (RM 0 to RM 4)
- Transition zone (RM 4 to RM 13)
- Tidal freshwater zone (RM 13 to RM 17.4)

Within each of these salinity zones, sediment grain size (which was characterized by Aqua Survey (2006)) will be used to further stratify sampling locations. Sediment is characterized as either fine (which includes silt and silt/sand combinations) or course (which included sand, coarse sand, and cobble).

Using GIS, spatial polygons were created to define the extent of coarse or fine sediments within each salinity zone, and 13 abundance sampling locations were randomly placed within each polygon (i.e., for 78 locations total site wide) (Figure 2). Actual sampling locations may vary somewhat from the proposed locations due to inaccuracies in global positioning system (GPS) readings

[1] Feeding strategies will be determined from available literature of observed taxa.
[2] Note that the term "majority-biomass" is used throughout the document in reference to this contingent sediment sampling depth.
[3] Sampling upstream of RM 16 is not feasible due to the coarseness of the substrate and shallowness for boat access in that area.

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or inability to collect an acceptable grab sample at the designated location (e.g., if sediment is too coarse to collect an adequate grab sample as defined in the Benthic QAPP).

Abundance and biomass by depth horizon

Sediment will be collected in the field using a pneumatically powered van Veen grab scoop following the methods and acceptability criteria described in Attachment D to the Benthic QAPP (Windward 2009), as well as Revision 1 to Attachment D, provided with this Addendum No. 6 to the Benthic QAPP. A clean, stainless steel tube (4-in. diameter by 8-in. height) will be used to collect specific horizons of sediment. The tube will be pushed into the sediment surface until the sediment surface is at the top of the tube and the deeper sediments are at the bottom. Sediment will be held in place in the tube with a flat piece of stainless steel or the Teflon extruder plug. The plug will then be used to push sediment up through the tube at measured increments (measured using a ruler or tape measure). The four depth horizons of interest are 0–2 cm, 2–4 cm, 4–10 cm, and 10–15 cm. A stainless steel bowl will be used to collect each sediment horizon as it is extruded; sediment that does not fall from the press during extrusion will be cut horizontally across the top of the press at the appropriate horizon depth using a stainless steel putty knife or similar implement. Sediment for each horizon will then be sieved using site water to remove fine sediment materials, and will then be rinsed again using an isotonic solution (Attachment BB) to remove salts from invertebrate tissues without causing tissues to rupture or degrade under osmotic stress.

In the field laboratory, unpreserved benthic invertebrates will be hand sorted in order to separate debris (e.g., leaf litter, rocks, wood-waste, and other refuse) from biological tissues prior to abundance and biomass analysis (biomass will be measured for approximately 30% of the collected samples). The number of individuals will be tallied using a hand counter.

Biomass will be determined on a subset of samples as follows: organisms will be rinsed with deionized water, vacuumed of excess fluids, and transferred to a pre-dried (i.e., ashed) and tared weigh pan (Attachment BB). The wet weight of the invertebrates will be measured using an analytical balance. Organisms will then be dried in an oven at 105 ± 3°C until a constant dry weight is reached (approximately four hours or overnight); this weight will be recorded. Dried biomass will be ashed in a muffle furnace at 575 ± 25°C for a minimum of one hour, and then a final weight measurement will be recorded. Once this process is complete, the AFDW will be calculated as the difference in mass before ashing (i.e., constant dry weight recorded in Step 3) minus the weight after ashing (Step 4). This AFDW value, which excludes the mass of inorganic materials in biological tissues that is not expected to contribute biomass to the food web, will be the reported biomass of each benthic invertebrate sample.

Benthic invertebrate tissue chemistry

For benthic tissue sampling locations, only tissue within sediment from the majority-biomass depth horizon (i.e., the benthic exposure zone identified using the results of the benthic depth horizon sampling) will be collected and composited. Each sediment subsample will be extruded into a bowl or directly into a 0.5-mm sieve, and rinsed with site water. Biological material will be hand separated into a weighed (empty) sample container, weighed with wet mass, and stored on ice. The process will be repeated at additional sample locations, with tissue from each location added to the composite sample until the mass requirement is met (see Worksheet 10:

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Project decision conditions). Samples will be stored frozen and shipped to the analytical laboratory prior to chemical analyses. A minimum of 12 g of wet tissue must be collected for each composite to analyze PCBs, PCDDs/PCDFs, lipids, and percent moisture. Additional mass (2 g ww) will be collected (for a total of 14 g of wet tissue) to minimize losses due to homogenization and other standard laboratory procedures.

Taxonomy

Sediment sampling for taxonomy will follow the same approach as for vertical biomass sampling, by collecting and processing a subsample from a sediment grab. Each taxonomic sample will be composited from sediment from the majority-biomass depth horizon (i.e., the benthic exposure zone identified using the results of the benthic depth horizon sampling) from four locations. All taxonomy samples will be rinsed with site water through a 0.5-mm sieve, and large rocks and debris will be removed. All remaining sediment and invertebrates will be preserved with a 10% buffered formalin solution. Preserved samples will be shipped to a taxonomic laboratory for analysis.

Who will collect and generate the data?

Windward will provide the field sampling coordination and laboratory coordination and support. Windward will also supply the field personnel, who will conduct the sample collection efforts. If necessary, additional field personnel may be provided by de maximis, inc. or Ocean Surveys, Inc. Germano and Associates will conduct the SPI survey.

How will the data be reported?

Daily updates on locations and sample collection progress will be communicated (e.g., telephone conversation or e-mail) to CPG and USEPA Project Managers (PMs) and Project Coordinators.

An electronic database, which will include the coordinates of sediment sampling locations and sediment sample characteristics recorded on the Surface Sediment Collection Form (see Attachment D of the Benthic QAPP (Windward 2009), will be provided at the conclusion of the sampling effort. Preliminary data will be available upon request.

Data reports summarizing the invertebrate biomass by depth and chemistry and taxonomy analyses results will be provided within 90 days after receipt of validated chemistry and taxonomy data. These reports will include a map that presents the actual locations of the sampling effort, along with a summary of any modifications to the proposed sampling plan outlined in this QAPP addendum.

How will the data be archived?

Data records, forms, and notes will be scanned and stored electronically in a project file. Hard copies will be archived at Windward's main office in Seattle, Washington. Data will be provided to USEPA in data reports and other acceptable electronic deliverables. The data reports will be issued and then archived both electronically and as a hard copy.

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